

# **Hybrid Inspection Method using Three Dimensional Scanning, Lock-in Thermography and Laser Shearography**

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The proportion of composite materials (such as CFRP) to the metal used on the modern aircrafts is rising, imposing different kind of failure modes. Since the composite structures are known to be sensitive to the impact loading, there is need for means to assess the sub-surface damage in the structure rapidly. Royal Netherlands Aerospace Centre NLR has an extensive track record on contactless non-destructive inspection (NDI) methods based on optical sensors, such as 3D surface scanning, lock-in thermography and laser shearography. The combination of these methods (multi-domain inspection) enables us to assess the structural integrity of an aircraft outer surface in a short time, reducing inspection costs and the “down time” of the aircraft. Recently, NLR is working towards a 3D oriented mesh environment of an object, enhanced with NDI data, providing sub-surface damage information. By automatically stitching the 3D object images, it is possible to expand this method for a complete scan of an aircraft surface. Furthermore, the thermographic and shearography imaging information has been integrated into the 3D surface accounting for the image distortion from the different measurement angles. In this paper, the results from the various studies will be presented involving integration of the 2D measurements with the 3D scan mesh and damage identification.